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Training Program: Pathway to Research Careers

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<b>13. Abstract (Maximum 200 Words) (abstract should contain no proprietary or confidential information)</b> We have established a three-phase training program to motivate talented undergraduate students, especially students from under-represented Southwestern minorities, to pursue careers in breast cancer research. Phase I provides a well-rounded introduction to the theory and practice of breast cancer research. This phase includes inquiry-based tutorials that integrate key concepts in normal and cancer breast biology; visits to specialized laboratories that utilize state-of-the-art technologies for breast cancer research; structured interactions with surgeons, medical oncologists and their patients, radiologists and pathologists in settings that introduce the clinical realities of breast cancer diagnosis and treatment; seminars presented by the Program's research mentors; a weekly, journal club that introduces current issues in breast cancer research while developing presentation and critical reading skills and a research project supervised by one of the program's mentors. During phases II and III, trainees have opportunities to continue their research projects throughout their senior years, and then in graduate school, respectively. The success of the program will be evaluated in the short term by the satisfaction of the trainees and mentors, and in the longer term by the number of trainees that goes on to graduate studies in breast cancer-related programs.				
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## **Introduction**

The objective of the *University of New Mexico Undergraduate Breast Cancer Training Program: Pathway to Research Careers* training program is to encourage and motivate undergraduate students, especially underrepresented Southwestern minority students, to pursue science careers related to breast cancer research. The **specific aim** is to establish a structured, well-rounded training program that provides experiences, tools, knowledge and motivation to pursue careers in breast cancer research. This report identifies the accomplishments and outcomes of the first year of this training program

## **Body**

The training plan was divided into three phases. The first phase consisted of an intensive summer training program in which trainees were introduced to the basic molecular concepts necessary for understanding breast cancer biology. In addition, students were provided with an introduction to research practice, and the ethical issues related to research. Students also had an opportunity to talk with patients, view surgeries and visit state-of-the-art service laboratories in addition to beginning their individual research projects in the laboratory of a funded breast cancer investigator. Phases II and III, which are fully supported by the Department of Biochemistry, allow students to progress through their Bachelor's degree and matriculate into graduate or professional school. The first cadre of 7 students has completed Phase I of the program and 5 are currently active in either Phase II or Phase III. Of these 7 students 4 were supported by this training grant and 3 were supported by the Department of Biochemistry and Molecular Biology.

The annual progress on the training program will be reviewed in the context of the 8 Objectives of the original "Statement of Work".

***Objective 1: Identify and recruit four sophomore and junior undergraduate students from the University of New Mexico, including women and minority students, to participate in the summer training program.***

Recruiting was limited to the University of New Mexico. Recruiting materials were circulated in introductory science classes and a description of the program was available on a web site dedicated to the "Pathways" Program. This web site obtains approximately 45,000 hits per month. A copy of the current advertising brochure is appended to this report. A selection committee of faculty mentors screened the applications and selected 7 participants for the first year of the program. The demographics of the initial class is shown in Table 1.

Table 1 Demographics of Pathways Participants

<b>Classification</b>	<b>Summer 2002</b>	<b>Summer 2003</b>
<b>Gender</b>	Female: 4 Male: 3	Female: 6 Male: 1
<b>Minority</b>	2	5
<b>Average years of college</b>	2.5	2.5
<b>Biochemistry majors</b>	3	1

It was judged that the method of recruiting was successful and a similar procedure has been implemented for the current year. The current year demographic data is also shown in Table 1.

***Objective 2: Provide Trainees a broad understanding of the basic concepts necessary to understand breast cancer biology and treatment.***

A set of 6 inquiry-based learning training cases was developed to introduce students to the concepts and vocabulary associated with breast cancer research and biology. Not only did the cases raise important biological issues but the students also addressed issues related to research ethics and patient behaviors. During the initial tutorial sessions it was determined that the students needed an opportunity to design experiments, ask experimental questions, and practice oral presentation skills. Consequently, the cases were appended to include these training opportunities. Initially it was anticipated that a seventh case would also be included in the training program, however, due to the modifications described above it was judged that there was insufficient time to include the additional case. A list of tutorial cases, case objectives and the schedule for the pathways program has been included in the appendix.

***Objective 3: Provide Trainees familiarity with state-of-the-art breast cancer research technologies.***

Tutorial cases included reference to and data obtained from modern research technologies. At the appropriate time in the cases opportunities to visit the core University service laboratories were made available to the Trainees. These laboratory visits included the Histopathology Laboratory, Microarray Laboratory, Gene Sequencing and Synthesis laboratory, and the Proteomics Facility. In all cases following the visit to the laboratory the students discussed the types of information obtained by these laboratories and the application of that information to their tutorial cases.

***Objective 4: Provide Trainees with an understanding of the clinical realities of breast cancer diagnosis and treatment.***

All Trainees were provided the opportunity to spend time with a histopathologist, a medical oncologist and his patients and view a surgery. Following each of these experiences the Trainees discussed their responses and what they gained in understanding from the physician and the patients. It was evident to the faculty of this program that these clinical experiences had an extremely powerful motivational effect on the students. These opportunities will be maintained in the program.

***Objective 5: Provide Trainees opportunities to learn about breast cancer research in the Health Science Center.***

Trainees were provided with an opportunity to visit breast cancer research laboratories within the HSC. These tours were not simply to view the facilities but each of the investigators or their research staff provided the students with a discussion of the question under investigation in the laboratory and how they were attempting to obtain answers. In addition, weekly breast cancer seminar series/journal clubs were developed in which the research mentors either discussed their individual research or discussed a seminar research publication. For these seminars the presenters were charged with formatting the discussion and presentation to the academic level of the Trainees. In addition, following the presentations the Trainees discussed their understanding of the presentation in the context of the tutorial meeting.

***Objective 6: Trainees will complete a research project in the laboratory of a funded breast cancer investigator.***

During the first two weeks of the program in an informal setting the Trainees were introduced to the research investigators and learned about the available projects. By the end of the two -week period students selected a research project. Trainees worked on these projects during the duration of the summer. A portion of the tutorial sessions were devoted to Trainees discussing their successes and frustrations with their research and updating each other on their progress. The capstone experience of the summer was an opportunity for the Trainees to present the results of their research in a public forum. A list of student presentations is included in the

appendix. To date 5 of these students have also presented their research at national or local meetings.

***Objective 7: Trainees will learn to read and present the breast cancer literature critically.***

The summer breast cancer seminar series, described above, alternated with a journal club discussion in which the Trainees read and discussed breast cancer research literature. Students also had opportunities to practice both reading the literature and presenting the papers in the context of the tutorials.

**Objective 8: Document satisfaction with the program and track student outcomes.**

Throughout the summer, weekly "brown bag" discussions were held with the program director. Due to the constructive relationship built between the Trainees and the faculty, these discussions were candid and provided valuable feedback to the program director. The dates of these feedback sessions are listed in the program schedule. Information obtained from the Trainees was frank, professional and obviously aimed at improving the program. The clinical and laboratory tours as well as the tutorial experience were well received by all Trainees. Trainee comments about their own learning, associated with these experiences, were some of the most positive comments ever received by the faculty. The comments related to the research experience, however, were variable. Five Trainees reported an outstanding and motivational relationship with their mentors while 2 Trainees experienced difficulty. The problems were in two different areas. One issue was faculty mentors competing for the strongest academic Trainees and rejecting others. The second issue was a lack of supervision by a mentoring faculty. Both of these issues have been addressed with the faculty mentors. We do not anticipate similar problems in the future and will modify slightly the procedures for allowing students to select a laboratory for their research experience.

It is premature to consider long-term Trainee outcomes. Of the original 7 students, 5 have remained with the program, continued their research and currently state they are planning on research careers. One student completed her undergraduate education in December of 2002. She has applied to MD/PhD programs and upon acceptance plans on focusing on cancer research. The two students who did not continue with the program were the same two students who had difficulties with either the research mentor or entering into a research laboratory. One of these students also experienced significant extracurricular events, which prevented her from continuing with the program.

**Key Research Accomplishments**

- Development of a formal comprehensive experience for Trainees that focuses on breast cancer research.
- Developed a set of 6 guided inquiry cases to help Trainees learn about breast cancer biology and research skills and ethics.
- Developed a set of laboratory tours and clinical experiences to supplement the training program and provide additional motivation for the students to continue with their research.
- Developed a public research forum for the Trainees to present their research accomplishments.

**Reportable Outcomes**

- Of the initial 7 students, 5 have remained with the program and are still focused on research careers.
- Of the initial 7 students, 1 graduated following the Fall 2002 semester. This student is applying to MD, Ph.D. programs.
- Five students have reported their research results at national or local meetings.

**B. Holder, M. Bisoffi and J. K. Griffith (2003) *Is there intra-tumor variability in telomere DNA content in human breast cancers?* 2003 FASEB Experimental Biology Meeting, San Diego, CA.**

Structure and Kinetic Properties of Lactate Dehydrogenases from Four Species of Human Malarial Parasites. TA Vanderjagt, WM Brown, **A Hoard**, LA Hunsaker, LM Deck, RE Royer, RC Piper, J Dame, MT Makler, DL Vander Jagt.  
**FASEB J 17, A981 (2003)**

W.M. Brown, **L.E. Metzger**, J.P. Barlow, L.A. Hunsaker, L.M. Deck, R.E. Royer, and D.L. Vander Jagt, 17-Beta-Hydroxysteroid Dehydrogenase type1: Computational Design of Active Site Inhibitors Targeted to the Rossmann Fold, **Chem Biol Interact 143-144, 481-491 (2003)**

**Amit, O., Pan, S., Jiang, Z., Evans, L., Taylor, C., Gauntt, B., Wan, H., Chen. X., Omdahl, J. and Hu, C.-A., A. (2002) Genomic and proteomic studies of apoptosis in cancer cells. Inaugural Genomics Symposium, The University of New Mexico.**

## Conclusions

The first year of the program was considered successful. No changes are anticipated in recruiting, laboratory tours, clinical experiences, seminars or the tutorial. During the second year of the program the program director will require a more formalized and consistent laboratory assignment protocol for the students. In addition, there will be more discussion with mentors about supervision of the Trainees once they are in the laboratory.

A component of the training program is a public service project designed by the trainees to increase public awareness of Breast Cancer Research or career possibilities. To address this issue the first year trainees elected to focus on the local UNM undergraduate community. The "Pathways" trainees this year formally chartered the UNM Undergraduate Biomedical Research Association to, which is designed to encourage undergraduate students to select biomedical research careers and support them in their academic careers. This is currently an active, formally chartered, UNM student organization.

## **Appendices**

### **Appendix 1: Current advertising brochure**



## **Pathways to Research Careers**

**Department of Biochemistry and Molecular Biology**

### **THE PROGRAM**

The Department of Biochemistry and Molecular Biology at the University of New Mexico School of Medicine provides full-time summer research opportunities for students entering their sophomore and junior year to conduct breast cancer research in the laboratory of a funded investigator for twelve weeks during June-August. Varied research topics are available to undergraduate students. The breast cancer research projects that trainees may pursue include:

- Development of new antimetastatic drugs
- Tumor suppressor gene function
- Mutational control of gene expression
- Mechanisms of cell death
- Mechanisms of tumor cell metastasis
- Nutritional control of gene expression
- Telomere biology

The program is supported by a training grant from the Department of Defense Breast Cancer Research Training Program. The purpose of the University of New Mexico Breast Cancer Research Training Program is to provide talented undergraduate students, especially students from under-represented Southwestern minorities, the experiences, tools, knowledge and motivation to pursue careers in breast cancer research. The Program includes classroom, clinical and research experiences that will provide a solid foundation for graduate studies and encourage the pursuit of careers in breast cancer research.

### **DURATION AND FUNDING**

The program for undergraduate students offers full-time research experiences for twelve weeks during the summer with a stipend of \$4000. There is the possibility of continuation of students' research projects beyond the first s

### **QUALIFICATIONS OF APPLICANT**

Sophomore and Junior students curious about potential careers related to understanding the biology of breast cancer are encouraged to apply for the program. Applicants must have successfully completed general chemistry and general biology courses and be in good academic standing. Student trainees will be selected on the basis of their essay, transcripts, and letters of recommendation.



### **SPECIAL ACTIVITIES**

Participation in the program requires participation in one Research Retreat upon completion of their projects.

Complete the information below and send with your completed application materials to:

## **HOW TO APPLY**

### **Applicants should submit:**

- a one page essay describing why they are interested in the Undergraduate Breast Cancer Summer Research Training Program,
- a description of prior research experience,
- a transcript, and
- three letters of recommendation.

### **and include contact information**

Name:

Address:

City:

State:

Zip:

School:

Telephone:

E-mail address:

**Send the above materials to:**

#### **PATHWAYS TO RESEARCH CAREERS**

**Undergraduate Breast Cancer Summer Research Training Program**

**Department of Biochemistry & Molecular Biology**

**915 Camino de Salud, NE**

**Basic Medical Science Building, Room #249**

**University of New Mexico School of Medicine**

**Albuquerque, New Mexico 87131-5221**

**Application materials must be received no later than  
MARCH 14, 2003.**

#### **REVIEW, NOTIFICATION, AND ACCEPTANCE**

Applications will be reviewed by an Advisory Committee. All applicants will be notified by April 1st of the results of the review process. Prospective trainees must affirm acceptance of their traineeship within 14 days of notification.

## **Appendix 2: List of tutorial cases and brief case objectives**

### **Case 1: Angie Landholm**

#### **Case Objectives**

- Student introductions
- Introduction to problem based learning
- Student identification of cancer related concepts

### **Case 2: Susan Murdahl**

#### **Case Objectives**

- Correlate cellular structure with normal structure and function of the breast and changes during pregnancy
- Normal and pregnant histology
- Mechanism of estrogen-dependent cellular proliferation
- Cell Cycle
- Apoptotic mechanisms

### **Case 3: Joyce Martinez**

#### **Case Objectives**

- Behavioral issues related to the diagnosis of cancer. How does the diagnosis of cancer affect the patient.
- Introduction to the vocabulary and concepts related to incidents of disease and relative risk.
- What is and what causes cancer: This should be a general discussion that relates back to the discussion of the cell cycle and apoptosis.
- Different kinds of cancer - vocabulary

### **Case 4: July Peters**

#### **Case Objectives**

- Epidemiology
- Steps in carcinogenesis
- Molecular Basis of Cancer

### **Case 5: Cancer Screening Tests**

#### **Case Objectives**

- Discussed the arguments supporting and rejecting mammography as a routine public screening program.
- Designed a public education program to increase breast cancer awareness.

### **Case 6: Doris Hernandez**

#### **Case Objectives**

- Staging of breast cancer
- Treatment options
- Experimental treatment options
- Community resources

### Appendix 3: Summer 2002 Pathways Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>MAY</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>
AM	Memorial Day			<b>Oncology Clinic</b> 10:00: Group A A. Mangalik, M.D.	<b>9:00 Microarray</b> B. Griffith
Noon			<b>Brown Bag, mentors</b> A. Hu, Ph.D.	<b>Brown Bag, mentors</b> D. VanderJagt, Ph.D.	<b>Brown Bag, Mentors</b> H. Hathaway, MD
PM		Tutorial 1:00 - 4:00 <b>Introduction to the program</b>		Tutorial 1:00 - 4:00 <b>Angie Landholm</b> <b>305 BMSB</b>	

<b>JUNE</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
AM	<b>9:00 Molecular Modeling</b>	<b>Oncology Clinic</b> 10:00: Group B A. Mangalik, M.D.	<b>Proteomics</b> 9:00 - Group B 10:00 -Group A		<b>Histology Lab</b> 9:30: 3rd Floor Lobby N. Joste, M.D.
Noon	<b>Brown Bag, mentors</b> Z. Shen, Ph.D.	<b>Pathways Seminar</b> R. Orlando, Ph.D.	<b>Brown Bag, mentors</b> S. Abcouwer, Ph.D.	<b>Brown Bag, mentors</b> M Brenneman, Ph.D.	<b>Brown Bag, mentors</b> R. Orlando, Ph.D.
PM	Tutorial 1:00 - 4:00 <b>Angie Landholm</b> <b>305 BMSB</b>		Tutorial 1:00 - 4:00 <b>Angie Landholm</b> <b>305 BMSB</b>		Tutorial 1:00 - 4:00 <b>Angie Landholm</b> <b>305 BMSB</b>

JUNE	10	11	12	13	14
AM					
Noon	<b>Brown Bag, mentors</b> J. Griffith, Ph.D.	Pathways Seminar <b>D. VanderJagt, Ph.D.</b>			<b>Brown Bag - Program Assessment</b> Griffith / Anderson
PM	Tutorial 1:00 - 4:00 <b>Susan Murdahl</b> 305 BMSB		Tutorial 1:00 - 4:00 <b>Susan Murdahl</b> 305 BMSB		Tutorial 1:00 - 4:00 <b>Susan Murdahl</b> 305 BMSB

JUNE	17	18	19	20	21
AM					
Noon		Pathways Seminar <b>Z. Shen, Ph.D.</b>			
PM	Tutorial 1:00 - 4:00 <b>Joyce Martinez</b> 245 BMSB		Tutorial 1:00 - 4:00 <b>Joyce Martinez</b> 245 BMSB		

JUNE	24	25	26	27	28
AM					
Noon		Pathways Seminar <b>S. Abcouwer, Ph.D.</b>			<b>Brown Bag - Program Assessment</b> Griffith / Anderson
PM	Tutorial 1:00 - 4:00 <b>Joyce Martinez</b> 245 BMSB		Tutorial 1:00 - 4:00 <b>Julie Peters</b> 245 BMSB		

JULY	1	2	3	4	5
AM					
Noon		Pathways Seminar <b>M. Brennemam, Ph.D.</b>			
PM	Tutorial 1:00 - 4:00 <b>Julie Peters 245 BMSB</b>		Tutorial 1:00 - 4:00 <b>Julie Peters 245 BMSB</b>		

JULY	8	9	10	11	12
AM					
Noon		Pathways Seminar <b>H. Hathaway, M.D.</b>			
PM	Tutorial 1:00 - 3:00 <b>To Screen 305 BMSB</b>		Tutorial 1:00 - 3:00 <b>To Screen 305 BMSB</b>		

JULY	15	16	17	18	19
AM					
Noon		Pathways Seminar			
PM	Tutorial 1:00 - 3:00 <b>To Screen 305 BMSB</b>		Tutorial 1:00 - 3:00 <b>Doris Hernandez 305 BMSB</b>		

<b>JULY</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>
AM					
Noon		Pathways Seminar A. Hu, Ph.D.			
PM	Tutorial 1:00 - 3:00 Doris Hernandez 305 BMSB		Tutorial 1:00 - 3:00 Doris Hernandez 305 BMSB		

<b>JULY</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>1</b>	<b>2</b>
AM					
Noon		Pathways Seminar			
PM					

<b>AUG</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
AM					
Noon		Pathways Seminar			Brown Bag - Program Assessment Griffith / Anderson
PM					

<b>AUG</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>
AM					POSTERS and PRESENTATIONS
Noon					
PM					